



EVALUATION REPORT – DIPLOMA THESIS

Thesis title: Time delay compensation algorithms for rolling mills

Author: Mert Okar

The objectives of the thesis originate from research activities performed within a project Centre of Applied Cybernetics 3 (CAK3), where the dynamics analysis and control design of rolling mills is being solved. The first objective – state of the art in the topic has been fulfilled in Chapters 1-4. After introduction to the problem of rolling mill control, two theoretical control design methods are outlined, Internal Model Control (IMC) for compensation of the relatively long measurement delay and repetitive control for eccentricity compensation. A summary of the approaches is outlined with references to the key literature sources [7] and [8] for IMC and [9] to [11] for repetitive control. The negative aspect of this part is that it includes too many copy - paste figures from literature (even though sources are cited properly).

Then, in Chapter 5, the physical model of the rolling mills is derived as 3DOF mass spring damper. Too many parameters of this model makes the identification difficult. Therefore, a simpler model is built based on the measured data. Note that the model selection (first order model with time delay) and its parameterisation have been done mainly by me. The student then extended the analysis applying fast Fourier transform in Matlab. The second objective – the application of IMC to compensate the input delay has been done in Chapter 6, including a simulation based validation. Then, based on the research results derived by our research team of CAK3, which will be presented in [12], the outline of methodology to unify the IMC and repetitive control is presented in Chapter 7. It consists of a filter design and artificial extension of the delay. Note that the procedure was designed by me, which is not clear from the thesis. Unfortunately, this part is not well described - it is too brief. It is also a mistake that the reference [12] is not included here (it is mentioned only briefly in the conclusions). The task of the student here was just to validate the approach by simulations, which has finally been performed, as demonstrated in Chapter 8. Consequently, in Chapter 9 the IMC scheme is converted to the repetitive scheme, including simulation based validation, by which the remaining objectives have been fulfilled.

To sum up, all the thesis objectives have been fulfilled. However, during the work on the thesis, aside the state of the art, which has been done carefully, most of the partial goals were generated with a considerable delay, which has accumulated. This has negatively affected the overall quality of the thesis, the key parts of which were written in rush – the figures are either copy-paste, there are also too many Simulink schemes, the text of the key parts is also rather brief and sometimes unclear. On the other hand, it needs to be stressed that the topic itself is relatively advanced and the student was able to comprehend most of the aspects and provided valuable simulation based validations of the proposed methods. Balancing all these aspects, **I recommend the thesis for defence with a grade C.**

In Prague, June 23rd, 2017

prof. Ing. Tomáš Vyhliđal, Ph.D.

Thesis supervisor

Department of Instrumentation and Control Engineering,

Faculty of Mechanical Engineering,

Czech Technical University in Prague